Self Contained Physics Demonstrations and Mind Teaser Kit

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The University of Antwerp presents a project for secondary schools, called "Physics is cool", It is approved and heavily sponsored by the Flemish departement of Science and Innovation, within the action "Wetenschap maakt Knap"(Science makes beautiful"). We put together more than 45 experimental kits with everything you need to do some 40 fascinating small experiments: all materials needed to do the experiments, an extensive teacher guide and a CD. Also teacher training sessions were set up.

1. Introduction:

As in many countries, also Flanders suffers from a decrease of young people studying physics. The average age of physics teachers with a physics degree is high and replacement is difficult to find, so that many physics courses are taught by non-physicists.
The ministry of Flanders, with its departement of Science and Innovation stimulates people to apply for funds to carry out projects in different fields. The project described below is in the field of physics education: new learning strategies and support of teachers in secondary schools. We hope to motivate and stimulate more young people to study sciences through more motivated and skilled teachers.

2. The project

We put together more than 45 experimental kits with everything you need to do some 40 fascinating small experiments: all materials needed to do the experiments, an extensive teacher guide and a CD. The experiments are in the field of optics (12), particle model (3), pressure in liquids (4), electromagnetism (5), forces (5), waves (7), and some combine different topics.
They are rather easy-to-do but sometimes difficult-to-explain; they are original and fascinating and many link to daily life physics.
Examples:

1. A vessel is filled with water. A laser beam is send through the water, just a few millimetres under the water surface. The laser causes a round spot on a screen. If one shines a 500W lamp on the water surface, the spots lowers and becomes stretched up to more than 50 mm. Explain this experiment. (Solution: the temperature gradient causes diffraction). Also sunlight is diffracted in the same way, it causes the weird shape of the sun at sunset
2. A bottle, filled with dry sand is put on the high side of an inclined plane. It rolls down all to the bottom. An empty bottle does the same thing. What happens to a bottle which is only half filled with sand? (The bottle accelerates first, but comes to stop somewhere halfway the inclined plane) Next: what happens if it is only a quarter filled with sand, or 80%, or with water, oil, peas, etc.?

As a help for the teachers we included: apart from the materials themselves to perform the experiments, a manual both on paper (in a 200 page binder) and digital (CD)is produced. For almost every experiment are included:
A small text describing the experiment
Questions directly related to the experiment
Hints which help to lead to a good answer, discussion
Additional tasks and questions
Applications
A scientific explanation of the phenomenon
A guide for the teachers in which didactical and pedagogical hints and guidelines are given: goals of a lesson, teaching methods and possible variations.
Apart from that, the CD contains a short movie of every experiment, performed by students of the Sint-Gabriëlcollege, a secondary school.

3. Didactical and pedagogical principles:

The experiments are in majority qualitative: they are meant to provoke discussions and improve scientific communication between students, to make them aware of the backgrounds of everyday phenomena, and to confront them with experiments which are rather easy-to-do but sometimes difficult-to-explain. The pedagogical hints include working in groups, summing up possible solutions and principles, suggest solutions, discussions, almost in a socratic way. Sometimes it is possible to make calculations and to do research on a quantitave base: this is only for "advanced" use of the kit's materials. It is also possible to use the experiments as teasers or as applications. It is "forbidden" to give explanations too quickly: as soon as an explanation is given, people tend to be satisfied and stop thinking, which is considered as counterproductive towards learning processes.

4. Practical

After approval of the project, the schedule below was followed in a two year process:
Select a number of experiments provided by Prof. A. Fischman (Kazan)
Add experiments known by different colleagues of a peering group.
Work them all out, test both experiments and working methods in a classroom situation (by 6 colleagues-teachers)
Feedback, corrections and last selection was made
All experiments are put in a handy doubledeck kit on wheels, with a platform to perform the experiments.
After a subscription procedure all teachers attend two half-days of training in performing the experiments, during which the principles and teaching methods were discussed. For every kit on the average two teachers per school were present. These sessions were quoted with an average of 4,65 on a scale of 5 on 10 criteria related to the kit, the physics, the project, the teaching methods and teachers' training.

5 Conclusion and future:

This initiative has been evaluated by the Flemish departement of Science and Innovation. It came out among the best in recent years in Flanders, and therefore a new grant was given. The project is now extended until December 2006. After this, more than 100 schools will be working with it in the near future. Due to the success, additional smaller kits will be composed: more experiments for 14-15 years old (particle model, forces, pressure, gases and transition phases of matter) and an extra kit for 16-17 years old (electrostatics,

electromagnetism, mechanics, waves). Apart from that we plan to assemble a kit for 12-13 years old and for 10-11 years old. More than 60 of these smaller additional kits already have been ordered.

References

[1] http://webhost.ua.ac.be/focus/Koffers/english.htm